

Factors Influencing the Inland Penetration of Atmospheric Rivers over Western North America

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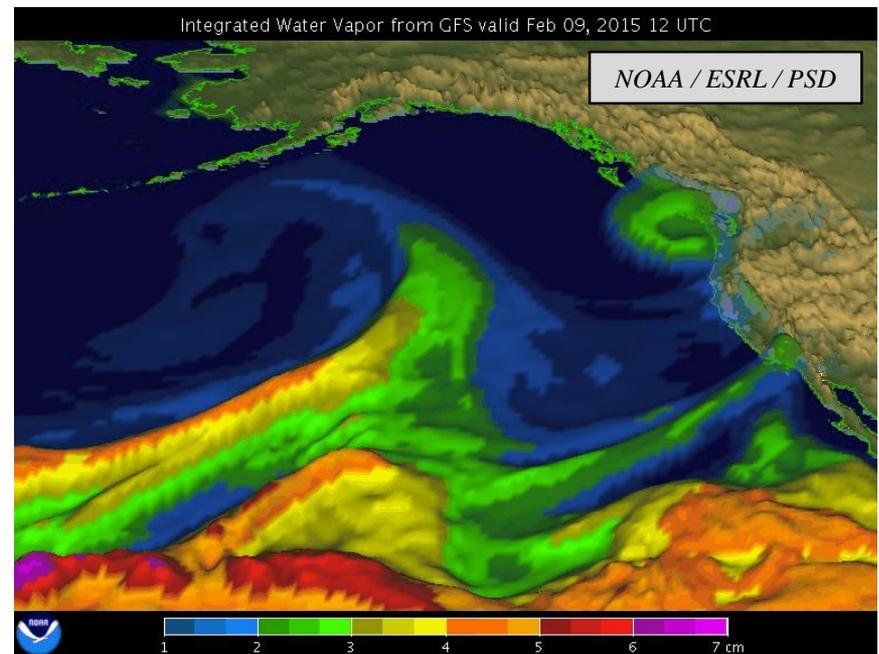


2016 International Atmospheric Rivers Conference
Thursday, August 11th, 2016



Motivation

- The climatology of ARs and their impacts along certain coastlines (e.g., U.S. West Coast) are fairly well known
- *But* the climatology of ARs and their inland penetration into interior regions (e.g., the interior western U.S.), and the relevant processes, are not well understood



Data and Methods

- Atmospheric Data
 - ERA-Interim reanalysis at 1.5° resolution
 - 6-h data during cool-season months (Nov–Apr); Nov 1988 to Apr 2011
 - Interpolated to 1-h data for trajectory analysis
- Precipitation Data
 - CPC: gridded 0.25° resolution; 24-h total valid at 12Z
 - SNOTEL: high-elevation; 0.1” resolution; hourly
- AR Identification method follows Rutz et al. (2014)
 - Length ≥ 2000 km; no width criterion; IVT $\geq 250 \text{ kg m}^{-1} \text{ s}^{-1}$ throughout

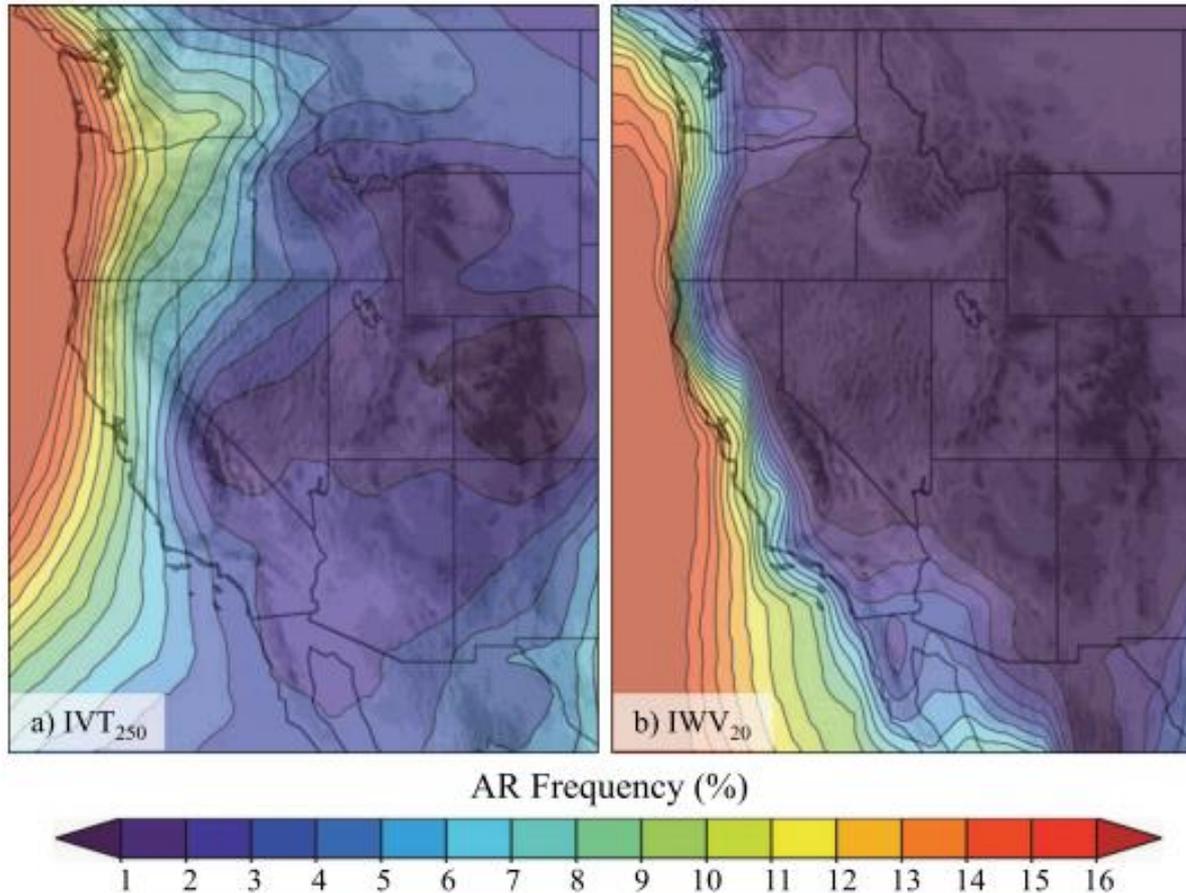


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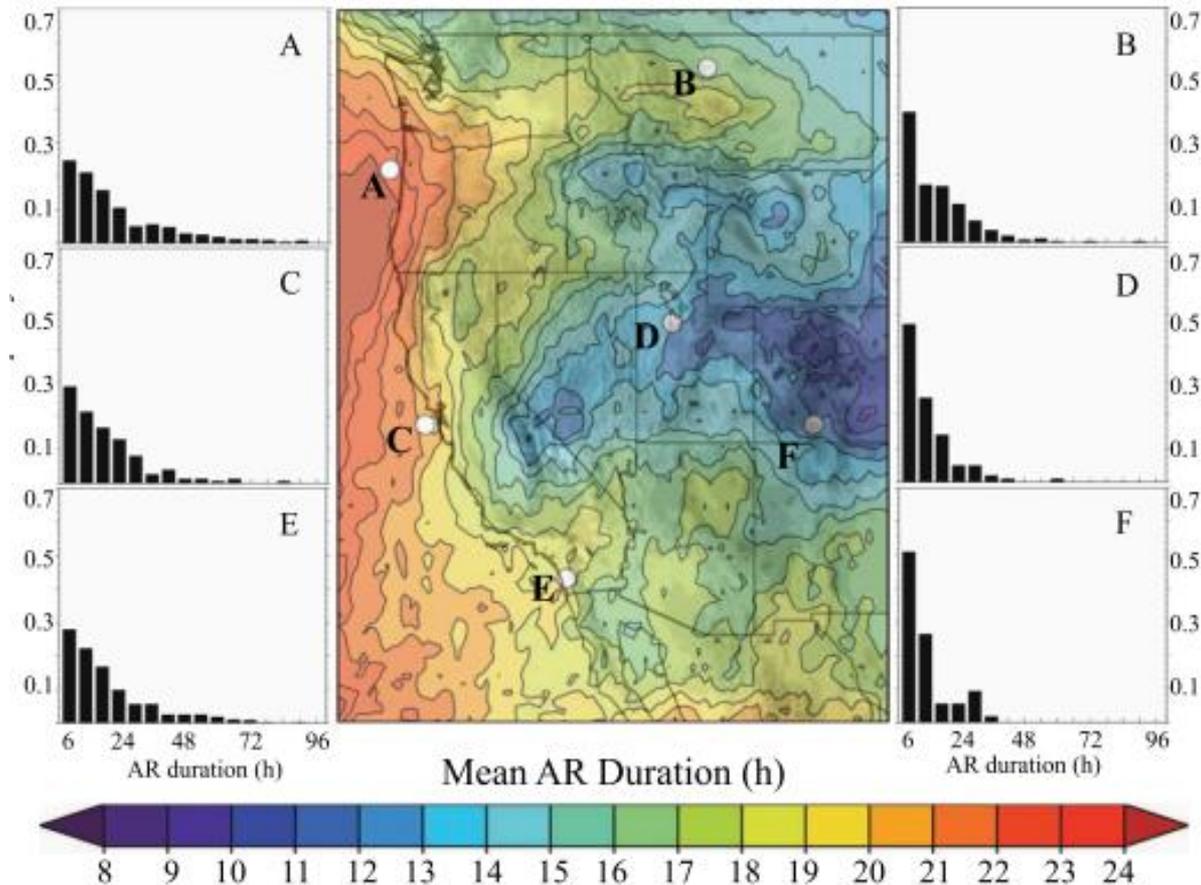


AR Climatology

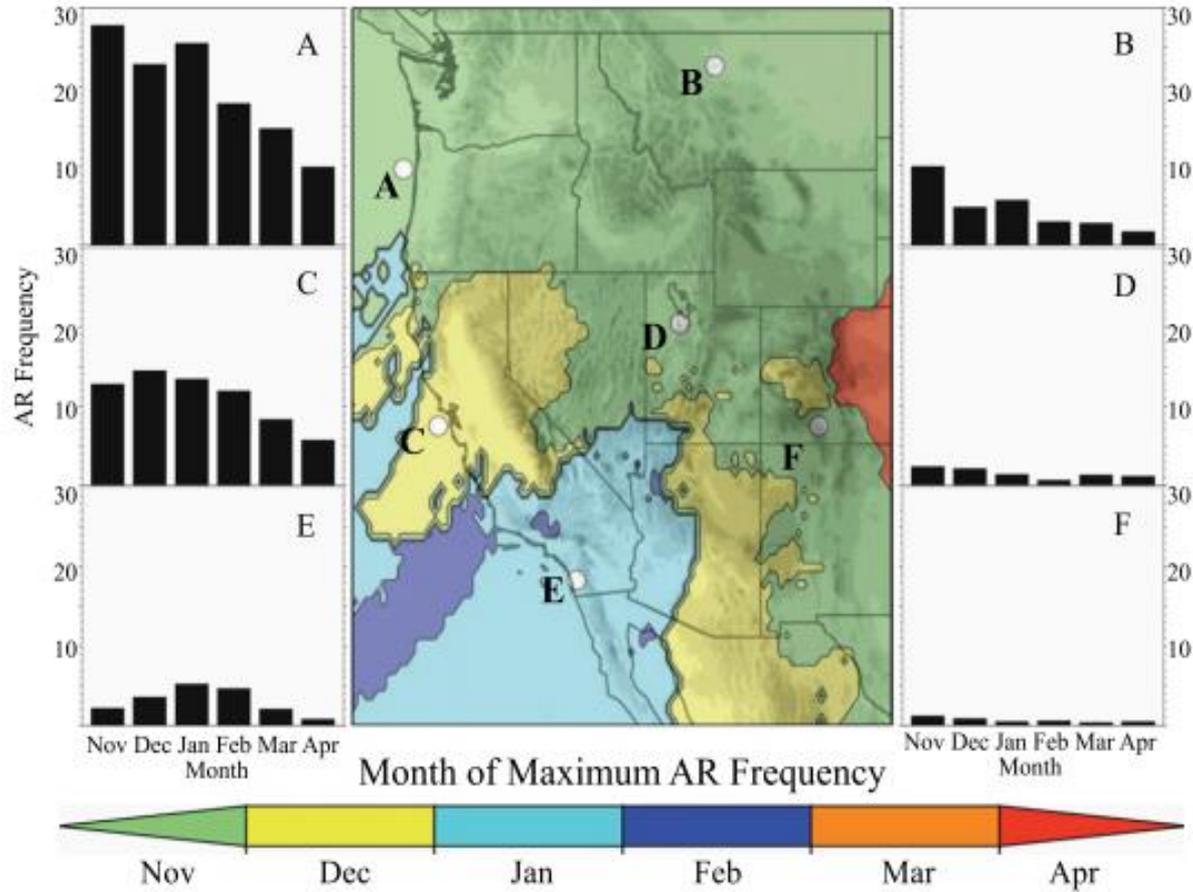
AR Frequency



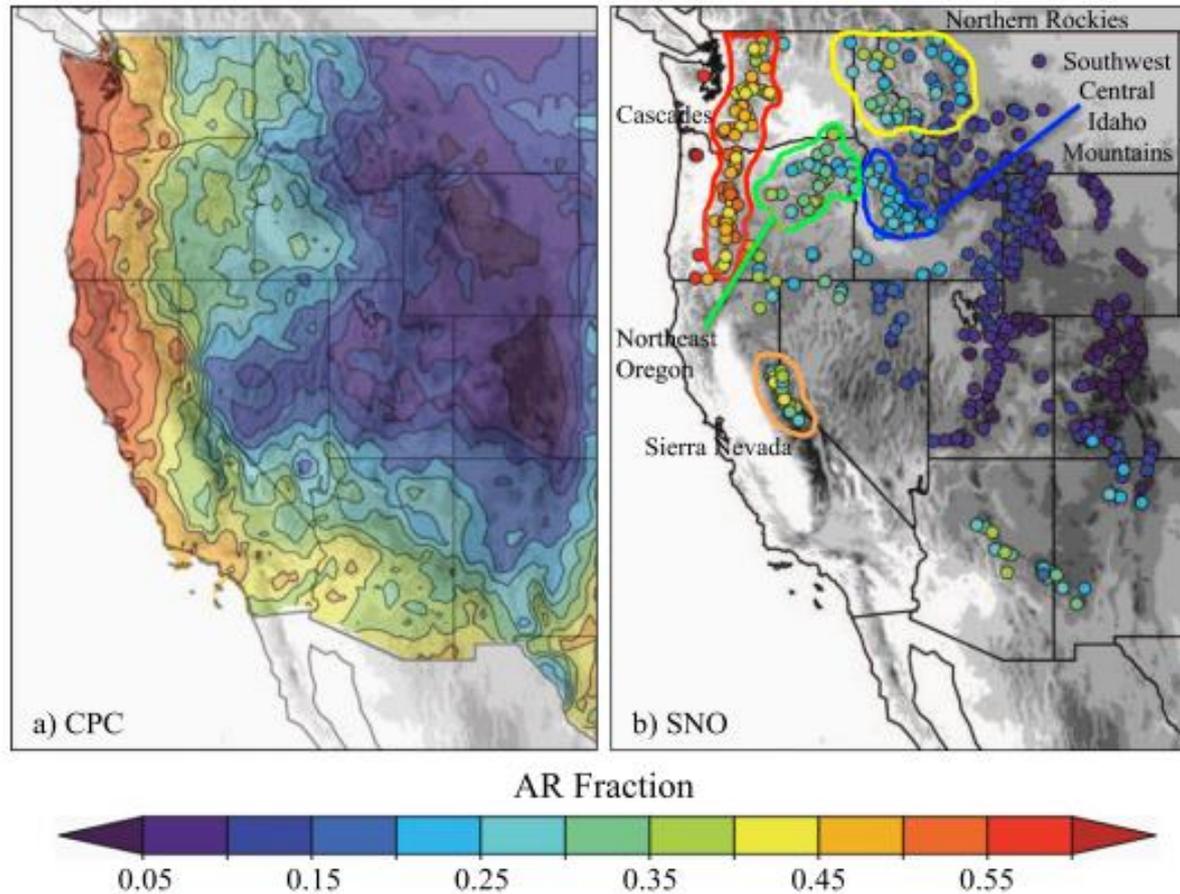
AR Duration



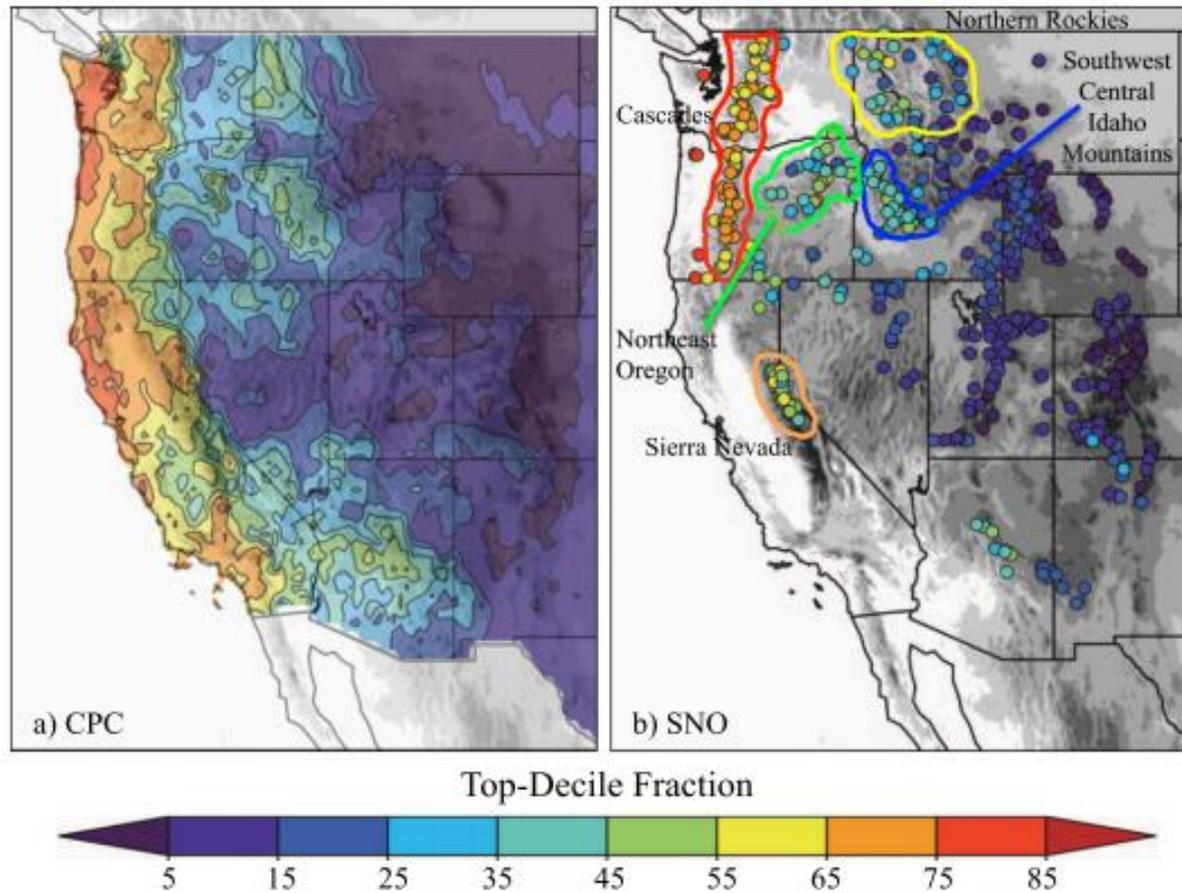
AR Seasonality



AR Contribution to Cool-Season Precipitation



AR Contribution to Top-Decile 24-h Events



Trajectory Analysis

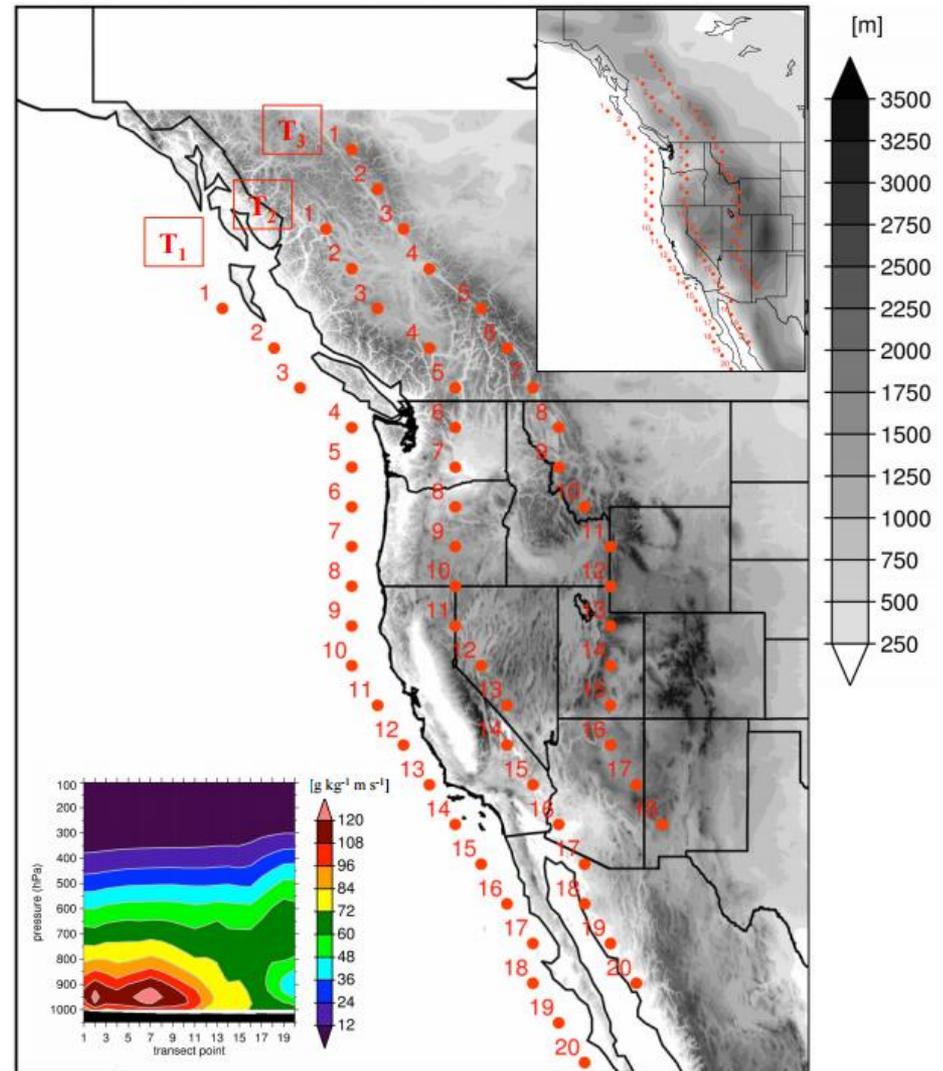
Trajectory Analysis Design

Trajectory Analysis:

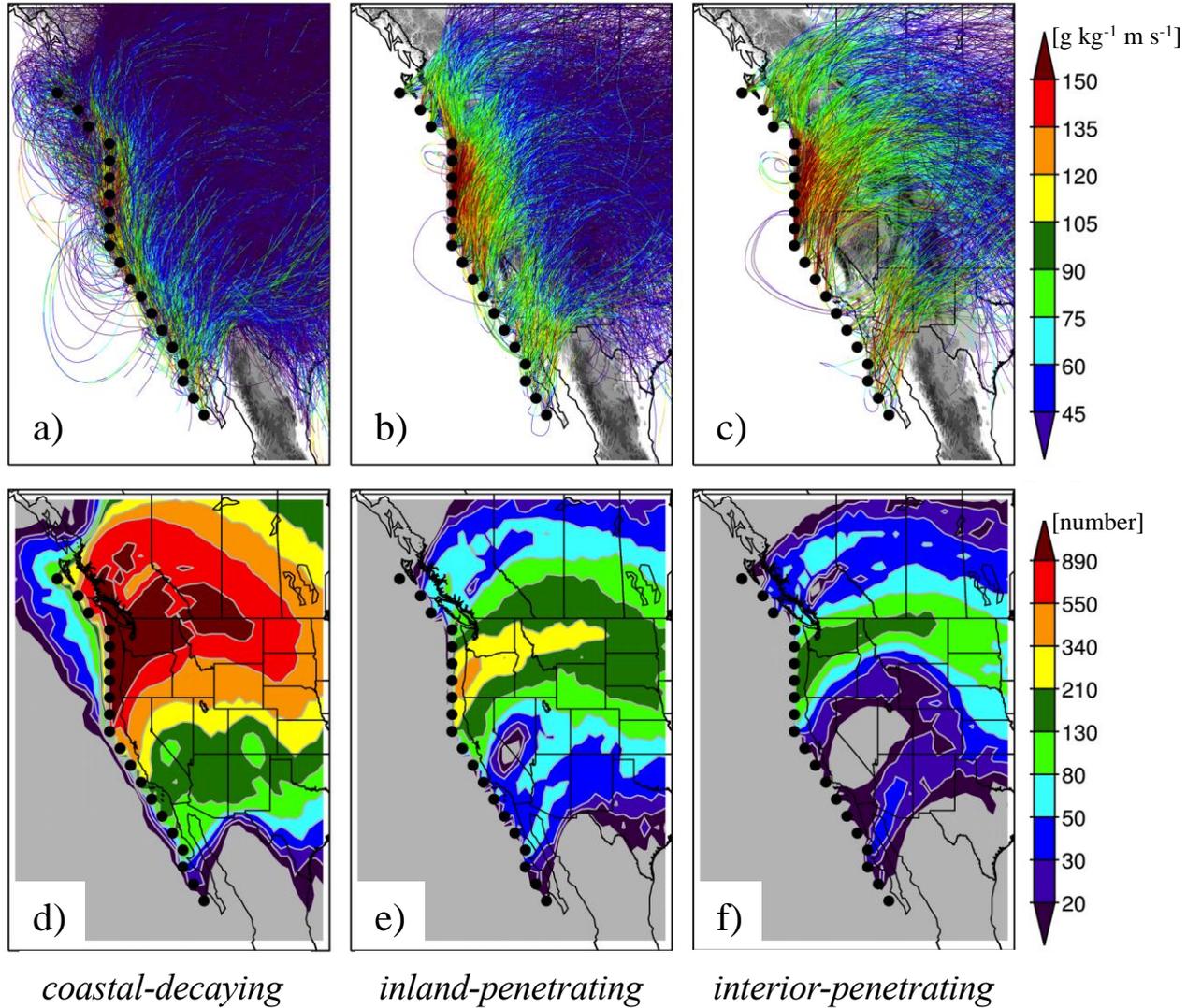
- Three transects (T_1 – T_3)
- If AR present at any T_1 grid point, trajectories initiated (950 & 700 hPa) from that point

Trajectory classification:

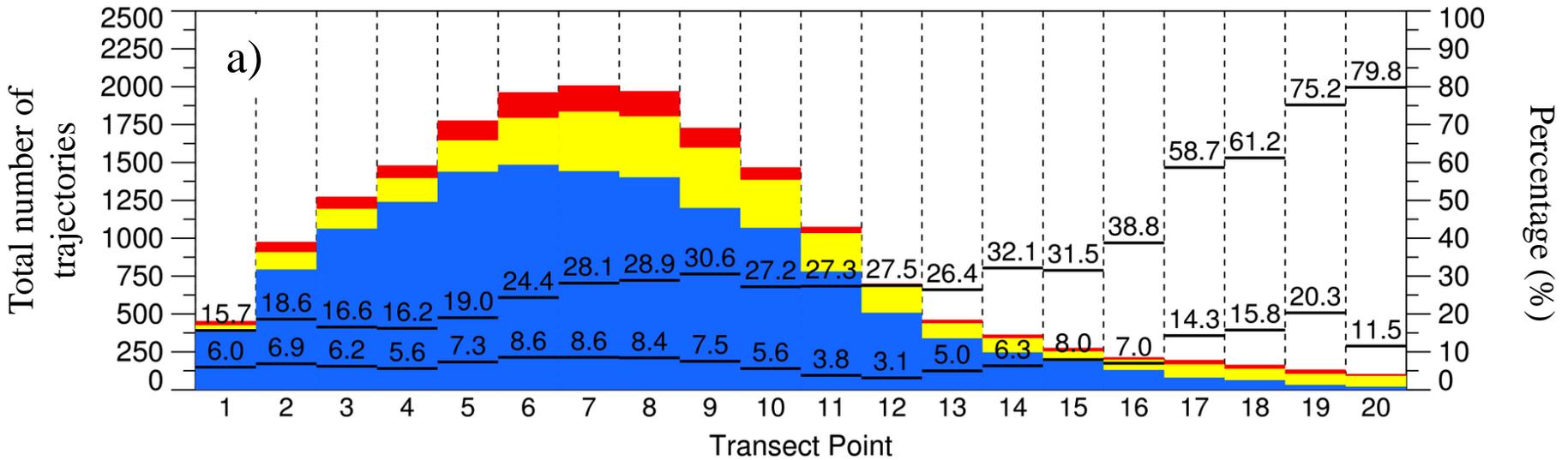
- *Coastal decaying*: no longer in AR at T_2
- *Inland penetrating*: still in AR at T_2 , but not T_3
- *Interior penetrating*: still in AR at T_3



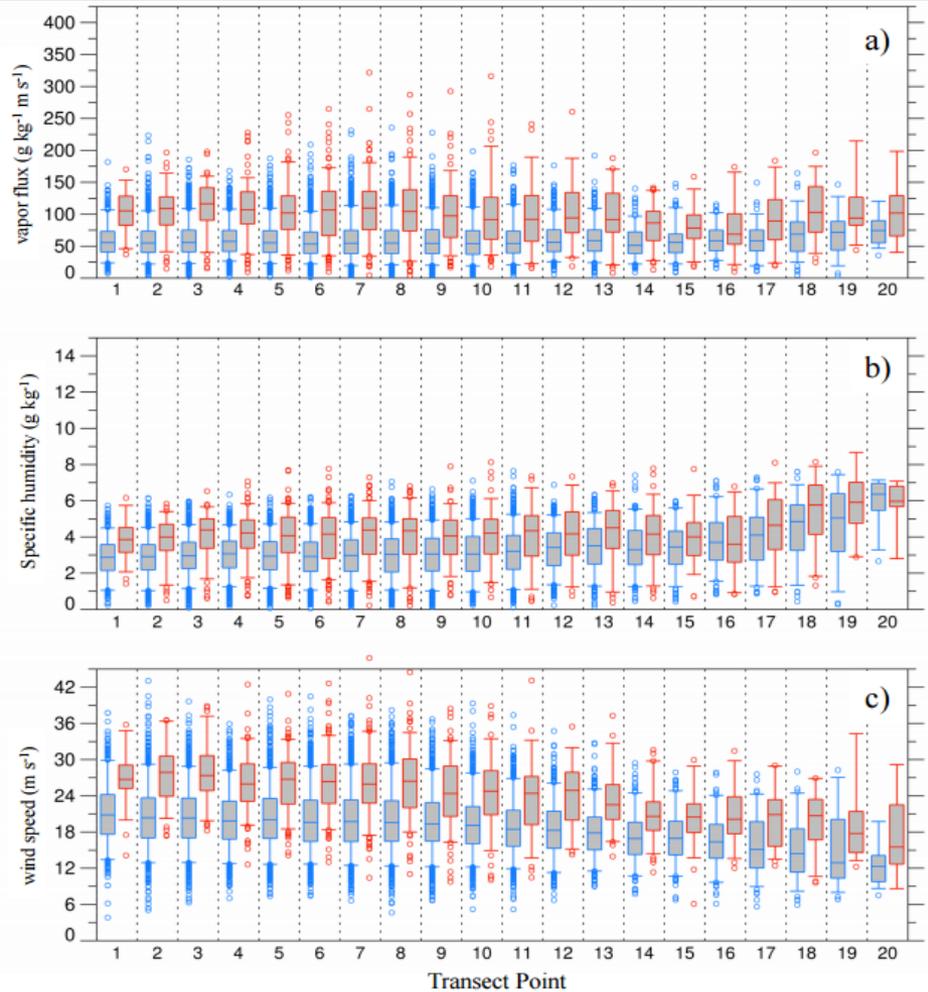
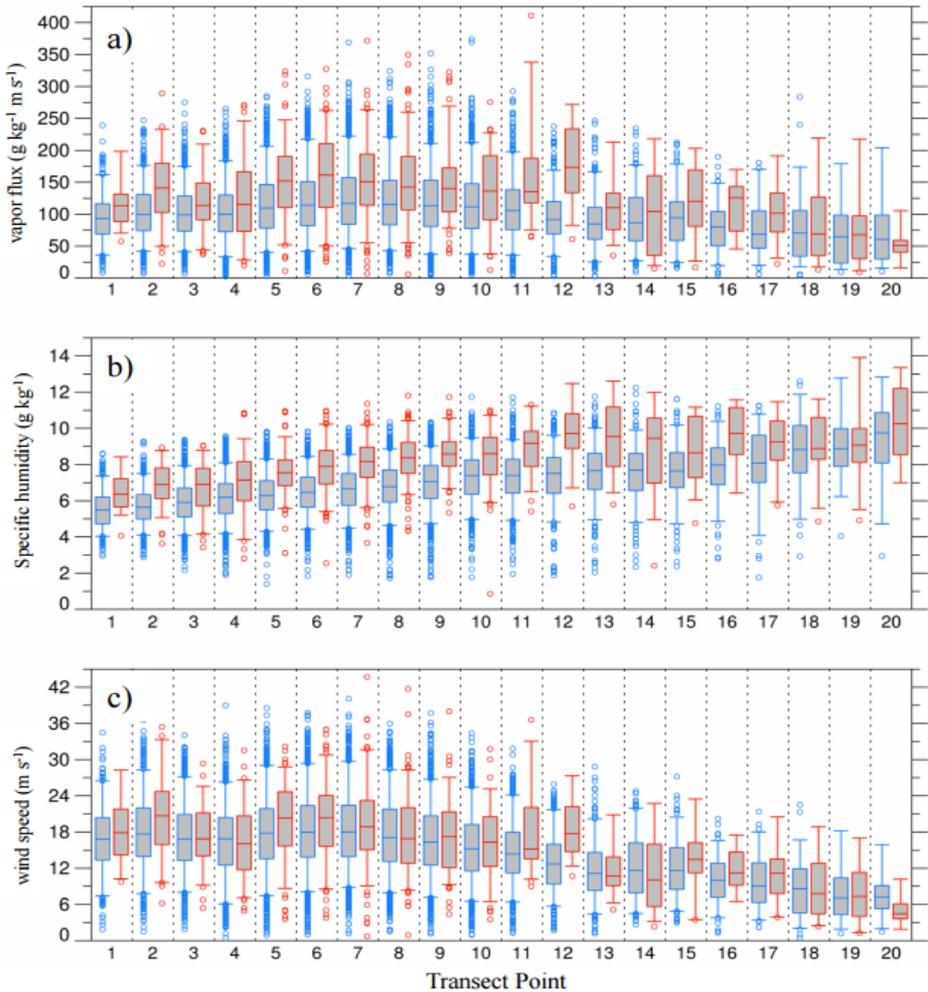
950-hPa Trajectories



950-hPa Trajectories

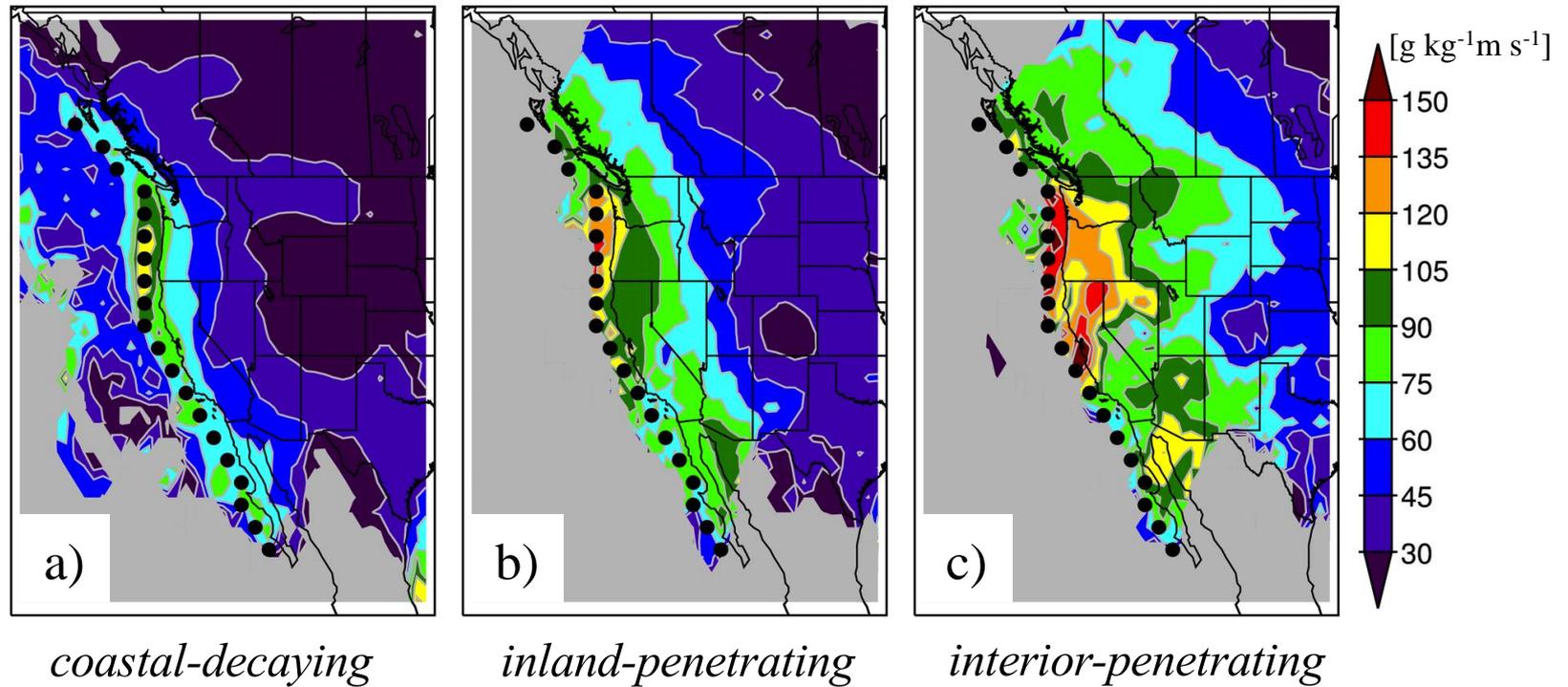


950-hPa Trajectories

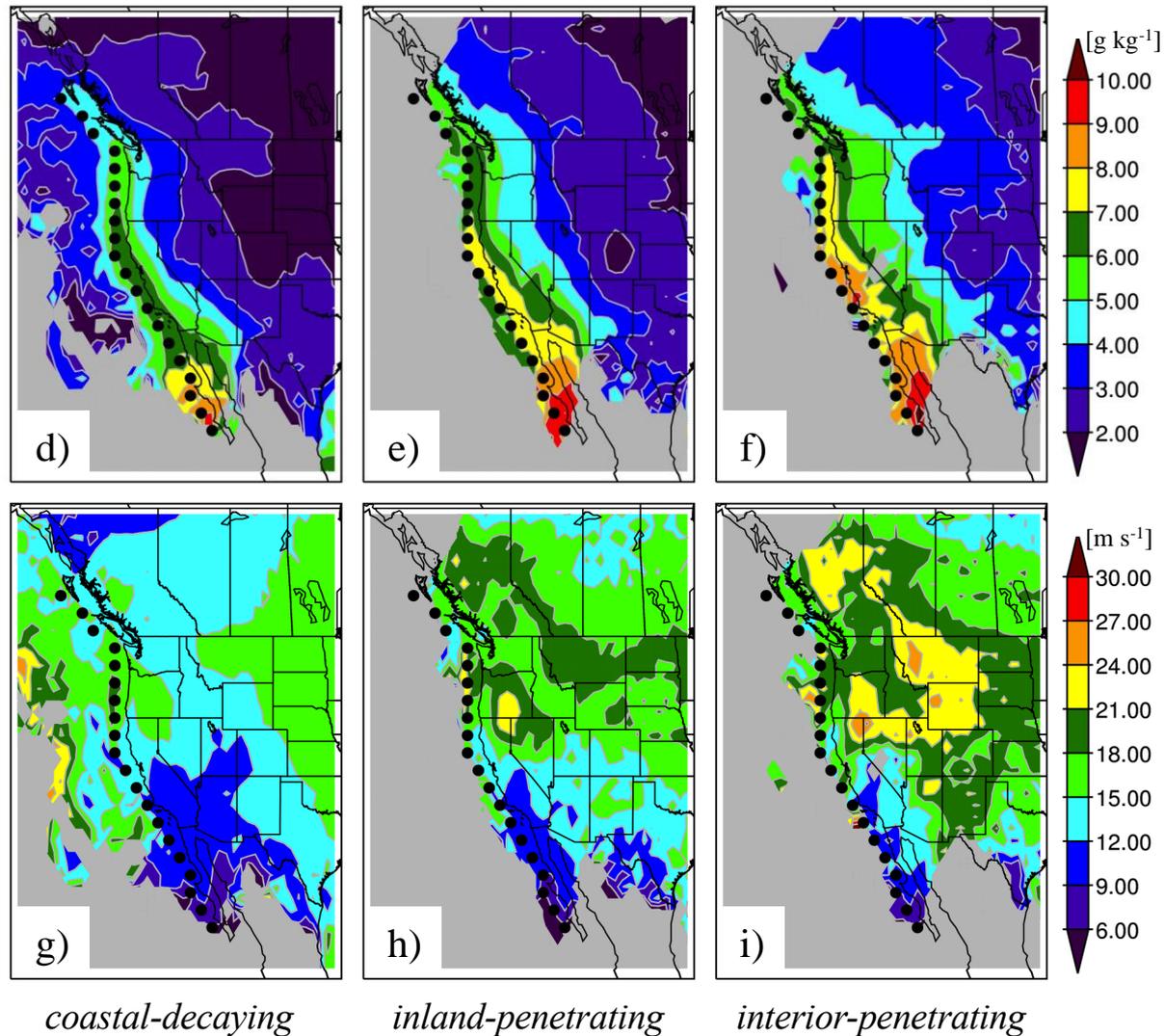


Trajectory Characteristics

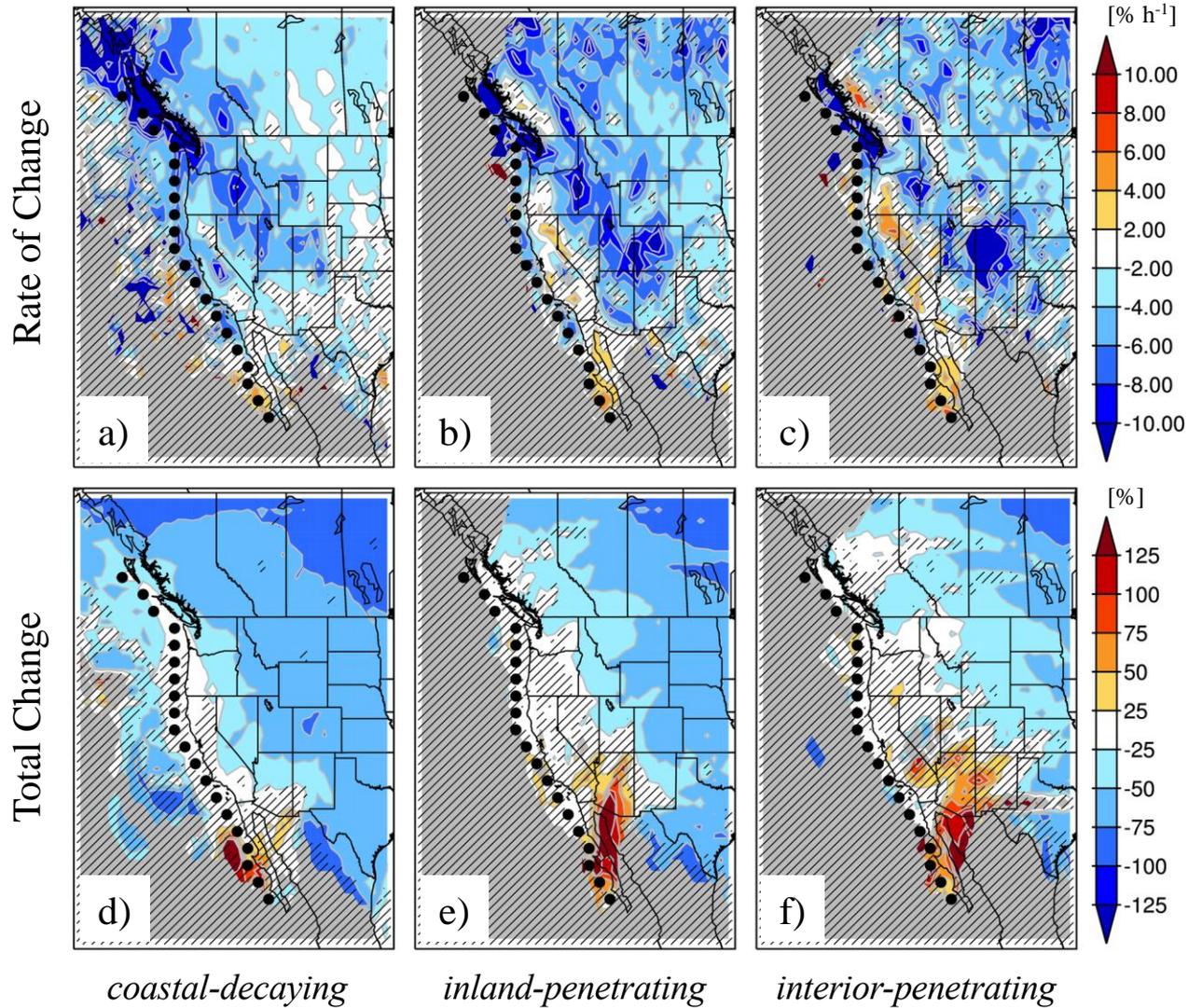
Water Vapor Flux



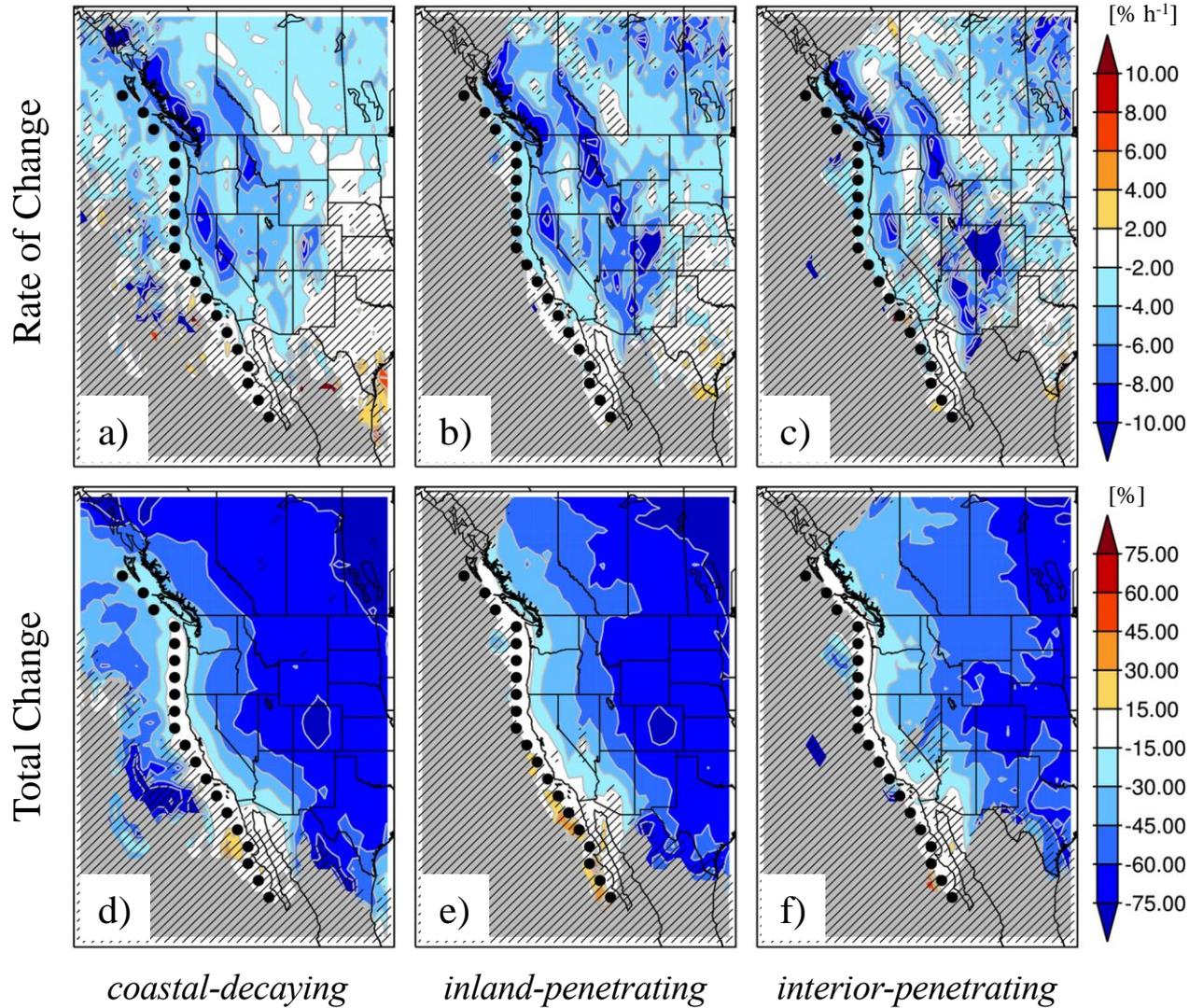
Specific Humidity and Wind Speed



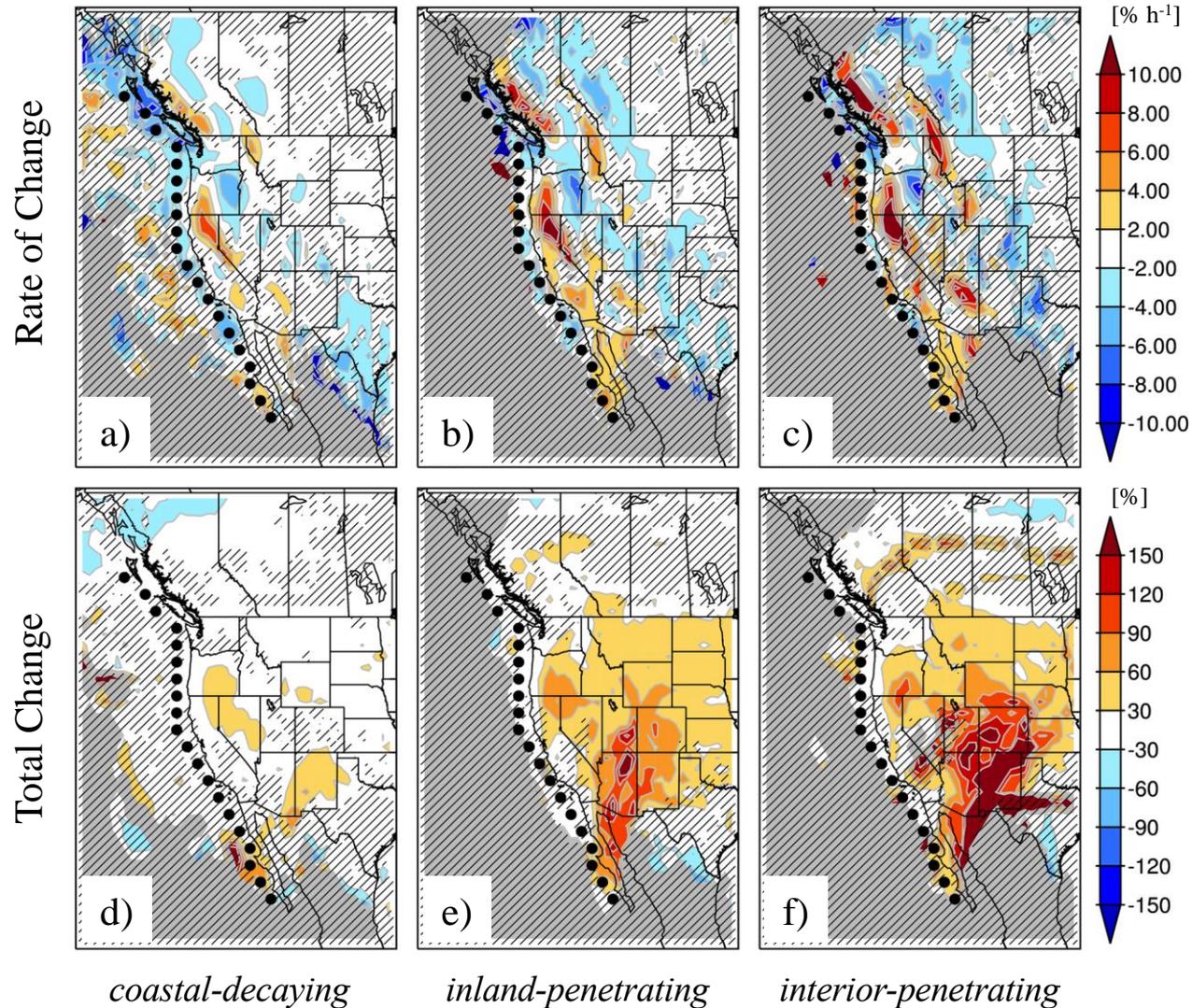
Changes in Water Vapor Flux



Changes in Specific Humidity



Changes in Wind Speed



Discussion

- Inland- and interior-penetrating trajectories lose a smaller fraction of initial water vapor, but not necessarily a smaller amount – they have more to begin with. These losses are at least partially offset by increases in wind speed, especially over the southwestern U.S.
- Why the increases in trajectory wind speed? A few ideas...
 - 1) Increase in elevation
 - 2) Northward movement into regions of enhanced baroclinicity
 - 3) Potential cyclogenesis over the southwestern U.S. associated with landfalling ARs

Summary

- AR climatology and inland penetration modulated by landfalling AR characteristics, and the orientation of the synoptic pattern relative to topography
- Can be understood in terms of three regimes...
 - PacNW: large number of ARs; modest inland/interior penetration
 - California: modest number of ARs; rare inland/interior penetration
 - Baja Coast: small number of ARs; frequent inland/interior penetration

